DEPARTMENT OF RECREATIONAL AND PHYSICAL EDUCATION.

GOVERNMENT OF BRITISH COLUMBIA.

Summary of lectures on
HEALTH.
(ELEMENTARY ANATOMY, PHYSIOLOGY, & HYGIENE.)

"Why study Health?" Huxley rightly attacked the classical education of the 19th century which ignored instruction in natural science, including human physiology. Even today, although our schools teach human physiology, their course in physiology cannot be compared in importance with the courses in, say, Latin and mathematics. Yet man's world has always been grounded solidly upon his body as its centre, and from it and its necessities, he has discovered practically all he knows about the universe.
Knowledge of the human body: It was not until the 5th century B.C. that Hippocrates, "the father of medicine", broke sharply with the superstitions of the time and looked upon disease as part of the order of nature and not as a "punishment from the displeased gods". And it was not until the 16th century A.D. that Vesalius, a Belgian whose "body was his Bible", recorded completely and accurately the structure of the body.
A definition of the Human Body: According to a modern physician (Dr. Logan Clendening), "the human body is an animal organism, differing in only a few respects from other animal organisms, and fitted, by the processes of selection and evolution, for the performance of two main functions: (1) the conversion of food and air into energy and into tissue, and (2) the reproduction of other individuals of the same species." The operations of the "mind and soul", he argues, may be understood under these two functions.
The cell doctrine states that "all living tissues are made up of units called cells, just as brick walls are made up of units called bricks". In other words, the cell may be called the "basic or fundamental structural unit of the body."
A typical cell is a microscopic portion of transparent, jelly-like material called protoplasm that is usually surrounded by a thin wall or membrane, and itself surrounds a more solid part called the nucleus. Chemically analyzed, the protoplasm is found to contain the fifteen elements which constitute the make-up of all living things. The lighter portion of the protoplasm surrounding the nucleus is known as cytoplasm.
Chief characteristics of cells: (1) Division or reproduction: (a) Unicellular (one-celled) or non-sexual reproduction--in dividing, the nucleus passes through a series of remarkable changes, the outcome of which is that it splits into two, and the protoplasm divides and arranges itself around the new nuclei. All regeneration of tissue, all growth, all healing of wounds depend upon this property of cells to divide and form new cells. (b) Multicellular (many-celled) or sexual reproduction--the female germ-cell and the male element fuse, interchange characteristics, and reproduce a single cell.
(2) Specialization: cells are specialized, some more highly than others: e.g. muscle-cells have a special structure which gives them the power of contraction and, therefore, movement.
Note: All cells are able to maintain life by converting food and air into energy and into protoplasm.
Tissue consists of a number of cells of the same kind found together.
Kinds of tissue: (1) epithelial--represented by the skin, the covering of the inside of the mouth, the coat of the stomach and intestines, etc.; (2) connective--comprising various cell groups, differing widely in appear-

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ance, such as tendons, bone, cartilage, etc., all of them helping to bind or cement the elements in the body; (3) blood--a true tissue, consisting of two different types of cells (the white and the red); (4) muscle--made up of two main types of cells to be discussed later; and (5) nervous--highly specialized cells which carry messages between the different parts of the body and the brain or the spinal cord.

An Organ is a group of tissues massed together in one place to perform a function or a set of functions: e.g. the liver, the eye, the lungs, the foot, etc.

Significance of the cell doctrine: As the structure of an organ depends upon the properties of the tissues composing it, so the characteristics of each tissue depend upon the properties of the ultimate structural units, the cells. Hence, if the cells must have proper food, oxygen, exercise, and rest, and must get rid of their waste matter to live and reproduce, then the body as a whole must have those essentials of life. In short, what is beneficial to the cells is beneficial to the body, and that which injures the cells also injures the body.

A System or Apparatus: an arrangement of organs closely allied to each other and set apart to perform some general function.

The Skeletal System.

Functions: (1) give shape and firmness to the body; (2) afford attachment to the muscles (support); (3) protect important organs--as in skull, chest, abdomen.

Structure: (1) Dorsal or back cavity--complete bony cavity formed by the vertebrae (bones of the spine) and by the bones of the skull, and therefore subdivided into: (a) the spinal canal (containing the spinal cord), and (b) the cranial cavity (containing the brain).

(2) Ventral cavity--not a complete bony cavity, part of its walls being formed of muscular and other tissue; much larger than the dorsal cavity; may be divided into: (a) thoracic or chest cavity (containing the trachea or windpipe, the lungs, the esophagus or gullet, the heart, and the great vessels springing from and entering into the heart), and (b) abdominal cavity (containing the stomach, liver, gall-bladder, pancreas, spleen, kidneys, small and large intestines, etc.) The thoracic and the abdominal cavities are divided by a dome-shaped muscle, called the diaphragm.

(3) Pelvic cavity (containing the bladder, rectum, and, in the female, the generative organs), or that portion of the abdomen lying below an imaginary line drawn across the prominent crests of the hip bones. It is more completely bounded by bony walls than the rest of the abdominal cavity.

Note: connected with the upper part of the ventral cavity are two small cavities: (a) Buccal cavity or mouth, and (b) Nasal cavity (containing the organs of smell).

Bone (or osseous tissue) is composed of: (1) mineral matter (chiefly phosphate of calcium, carbonate of calcium, and other salts) which makes it hard and strong; and (2) animal, organic, or soft matter (chiefly blood-vessels and connective tissue). Mineral matter constitutes about 2/3 of the weight of the bone, and animal matter about 1/3. The bones are softer in early life because the animal matter predominates.

Bony tissue has two forms: (1) the dense or compact (close in texture); and (2) the spongy (open or cancellated). Though the first form appears as solid as ivory, both are porous to a lesser or greater degree, but in all bones the compact tissue is the stronger.

The shafts of the long bones are almost entirely made up of the compact

substance, except that they are hollowed out to form a central cavity, the medullary canal, which contains marrow. Outside of the bone is a tough but fribrous membrane called the periosteum, which is largely concerned in the process of bone repair, for if a portion of the periosteum be stripped off, the bone under it will be liable to die.
Over the top of the bone where it meets another bone at a joint surface is a white elastic substance called cartilage.
Classes of bone (according to their shape): (1) long--more or less curved for greater strength, locomotion, and more graceful outline; e.g. arm and thigh bones; (2) short--of spongy texture throughout, except at their surface where there is a thin crust of compact substance, and made primarily for strength; e.g. wrist and ankle bones; (3) flat--for protection and for muscular attachment; e.g. shoulder-blade, rib, and cranial bones; (4) irregular--cannot be grouped under the above headings because of peculiar shape; e.g. vertebrae.
Bones of the skull: arranged into (a) bones of the brain case (cranium); and (b) bones of the face. With the exception of the lower jaw, the bones of the skull are firmly united, so that movement between them is impossible.
Bones of the arms, forearms, wrists, hands, and fingers are: humerus, radius, ulna, carpal, metacarpal, and phalanges.
Bones of the thighs, legs, feet, ankles, and toes, are: femur, tibia, fibula, tarsal, metatarsal, and phalanges. Also the knee-cap or patella.
The ribs: consist of 12 pairs of curved bones extending from the thoracic vertebrae to the front of the body, and are known by numbers (1st, 2nd, etc.) commencing from above. Upper 7 pairs called "true" ribs, lower 5 pairs--"false". Of the false ribs, the last 2 pairs are unattached to the sternum (or breast bone) in front, and are called "floating". They allow for lung expansion.
The spine: because it is made of so many (33) short bones and joints it can bend freely and rarely breaks. Besides acting as a shock-absorber to the body by virtue of its double-curved shape, the spine contains the spinal canal which encloses the spinal cord.
Joints: "places where the bones come together."
Classes of joints: (1) Immovable--found where great strength and firmness, but no movement is required (e.g. in the cranium); and (2) Movable--divided into: (a) ball-and-socket joints (e.g. shoulder and hip joints, allowing movement in any direction); (b) hinge joints (e.g. knee and elbow joints, also first two joints of the fingers and toes, permitting motion only in two opposite directions); (c) gliding joints--(e.g. between the small bones of the ankles and wrists, moving or gliding a slight distance upon each other). Dependent upon these different joints are:
Kinds of movement: (1) Flexion--bending; (2) extension--straightening or stretching out; (3) abduction--motion from the centre-line of the body; (4) adduction--motion towards the centre-line of the body; (5) rotation--turning upon its own axis; and (6) circumduction--circular movement.
Common injuries to the bony framework: (1) fractures, or the breaking of bones; (2) dislocation, or the unapproximation of joints; and (3) sprains, or the tearing of the ligaments without either fracture or dislocation. A simple injury may be more than "only a sprain", and must not be allowed to go on without examination, i.e. examination by the X-ray.
Treatments of fractures depend upon holding the broken ends of the broken fragments of the bone in place until the process of healing takes place, i.e. until connective-tissue-cells are thrown across the gulf, and along them bone-forming cells later begin to lay down new bone.
Posture: Because the bones are softer in early life, it is important that the skeleton be kept in its proper position during childhood and youth.

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The erect position should be maintained with the least possible strain on the muscles and tissues which hold the bones and joints in their proper place. Posture points to remember: (1) the body should be supported by both feet equally, with the feet turned practically straight forward (weight evenly distributed on main arch); (2) knees should be braced but not unduly forced back; (3) tilt or angle of the pelvis--faulty posture may be due to exaggeration in either direction: (a) bantam position; (b) "slack" or tired position; (4) the normal curves of the spine should be maintained, neither increased, nor lessened; (5) the shoulders should be allowed to drop so the arms hang loosely and there is no rigidity in the shoulder joint.

Some common abnormal conditions of the feet: (1) Weak feet--caused by postural defects, the relaxation of the muscles supporting the bones causing the"settling" of the feet. Result: no agility. (2) Strained feet--often outcome of faulty footwear. With women the condition of Anterior Metatarsalgia (the falling of the anterior or transverse arch) is common, and is due to the wearing of very high heeled shoes--especially by girls before maturity--with the result that the flexibility of the foot is diminished. Symptom: acute pain under the head of the metatarsal bones; the pain is sudden and relief may not be obtained until the shoes are removed, the pressure is released, and the bones adjusted.

The selection of proper shoes is hence most important. A good criterion of a fine shoe is its flexibility.

(3) Flat feet--occur when either or both of the two arches break down, or their ligaments become stretched, or the muscles give way. Common causes: (a) faulty footwear and hard pavements; (b) disproportion between our size and weight, and the size of our feet; (c) increase in weight as we grow older; and (d) a sudden jump and a heavy landing. Note: the tragedy of flat feet is not only pain (which is often more distressing when the arch begins to sag and muscles tug to keep it up, than when complete collapse has occurred and the muscles have resigned themselves) but in disability, in the cutting off of ordinary activities, exercise, etc.

Treatment for flat feet will vary with each case, depending on its causes, but in general it may take these forms: (a) exercises to strengthen the muscles of the calf and foreleg; and (b) carefully designed shoes. The use of arch supports or plates is occasionally justifiable, but usually they support too much and hence eventually weaken the muscles whose business it is to support the arch. Among exercises for flat feet are: (1) continued walking with the feet slighly inverted (i.e. putting more weight on the outer borders of the feet); (2) standing with the arches drawn up; (3) sitting with one leg crossed over the other, and foot circling; (4) sitting and gripping the ground with bare feet, or picking up objects with the toes.

Painful feet: Usual cause of painful feet is not flat feet. Pain is due to the inflammation of a series of bursae, or small serous sacs (cushion-like), located on the bottom of the feet, one under the heel, several just between the roots of the toes. Removal of these bursae by a simple operation has resulted in the cure of many so-called flat feet.

Treatment for sprains (common gym.floor injuries): Where ligaments which guard the joint (e.g. ankle or wrist) become stretched or torn, the accompanying swelling is due to the bleeding from the torn blood vessels of the ligament affected, and therefore to prevent this swelling, with its pain and tension, elevate the injured part, and apply ice or cold water to it. Then apply a snug bandage, placing the joint at rest midway between flexion and extension. After the acute stage has passed and the swelling diminished,

hot compresses may be applied, and the part massaged towards the body.

The Muscular System.

Our muscles are more than 500 in number. Their combined weight is over 2/5 of the entire weight of the body. Muscles contain about 75% of water and a considerable quantity of salts. Living, resting muscle is alkaline; hard worked or dying muscle is acid.

General functions of the muscles: (1) movement of the body; (2) give body roundness and shapeliness; (3) afford protection to certain cavities and bones (e.g. abdominal cavity; ribs); (4) support or hold bones together at joints.

Chief parts of a muscle: in its commonest form a muscle consists of a soft red middle part, called its belly, which tapers towards each end, where it passes into one or more dense, white inelastic cords (tendons) made of connective tissue, which attach the muscle to parts of the skeleton. The belly of a muscle is its working part: it receives nerves which, when excited, cause it to contract. In so doing, it pulls on the tendons, and they transmit the pull to the parts to which they are attached. The tendons are often quite long, so that our limbs are comparatively light and slender.

The origin of a muscle is that part of the skeleton to which the inner (i.e. nearer the centre of the body) end of the muscle is attached; the insertion is that to which the outer end is attached.

Kinds of muscles: muscle fibres are of two different kinds, and we therefore distinguish two varieties of muscular tissue: (1) the striped or striated, which is nearly always under the control of the will, and is often spoken of as voluntary muscle; also called skeletal, because of attachment to bones which they move or assist in holding in place; and (2) the plain, unstriped, or non-striated, which is usually withdrawn from the control of the will, and is therefore termed involuntary. This kind of muscle is found arranged around the blood vessels and hollow viscera (organs of the abdomen and the chest), and thus is also called visceral. An exception to the above is the muscle of the heart (cardiac), as it is a striated muscle, but involuntary.

Antagonistic muscles: many muscles are in pairs, each muscle of the pair working against the other, and hence termed antagonistic. The accuracy of movement is determined by the action of these muscles, since muscles have the power of contraction(pulling), but not of pushing.

Location and action of some of the more prominent outer muscles of the body:

In the neck: sternocleidomastoid: origin--sternum and clavicle; insertion--mastoid portion of the temporal bone; action--flexes the head and rotates the face to the opposite side.

On the back: (a) trapezius: origin--occipital bone and all the thoracic vertebrae (12); insertion--clavicle and scapula; action--draws head backward or sideways; also elevates the shoulders. (b) latissimus dorsi: origin--last six thoracic vertebrae, and lumbar and sacral part of the spine; insertion--a groove of the humerus; action--draws arm downward and backward and rotates it.

In the chest: pectoral muscles: (a) pectoralis major arises from the sternum, the clavicle, and the 6 upper ribs; it is attached to the humerus; action--draws the arm downward and forward; also aids in chest expansion. (b) pectoralis minor--entirely covered by the major; it can lower the scapula and depress the shoulder.

In the abdomen: (a) external oblique: origin--lower 8 ribs; insertion--the crest of the ilium; action--compresses the viscera and flexes the thorax. (b) internal oblique--just below the external, and its action very similar

to the latter's. (c) rectus abdominis: a long, flat muscle arising from the pubic bone and inserted into the cartilages of the 5th, 6th, and 7th ribs; action--compresses the abdomen and flexes the body.
In the upper limbs: (a) deltoid--coarse, triangular muscle covering the top of the shoulder; origin--clavicle and spine of the scapula; insertion--middle of the shaft of the humerus; action--raises the arm from the side so as to bring it at right angles to the trunk; also aids in carrying it forward and backward. (b) biceps: spindle-shaped muscle, occupying the whole of the anterior surface of the arm, and divided above into two portions or heads (hence its name) attached to the scapula; insertion--radius bone; action--supinates and flexes the forearm, and flexes and adducts the arm. (c) brachialis: below the biceps, and actually larger than the latter; action--flexes the forearm. (d) triceps: extends the whole length of the posterior surface of the humerus; divided above into three heads (hence its name); origin--scapula and posterior surface of the humerus; passes downward, all its heads uniting in a common tendon which is inserted into the ulna; it is the great extensor muscle of the forearm and arm, and the direct antagonist of the biceps. (e) pronators and flexors on the front and inner part of the forearm; extensors and supinators on the outer side and back of the forearm--also work against each other. Pronators turn the palm of the hand backward and, when the elbow is flexed, downwards or prone; the supinators turn the palm of the hand forward and, when the elbow is flexed, upwards or into the supine position. The tendons of these muscles are held close to the bones of the wrist by annular (circular, band-like) ligaments.
In the lower extremity: (a) glutei, or 3 gluteal muscles: form the chief prominence of the buttock; coarse in texture, they are largely concerned in supporting the trunk upon the head of the femur, and in bringing the body into the erect position when the trunk is bent forwards upon the thigh. (b) psoas magnus--the great loin muscle; origin--last thoracic and all the lumbar vertebrae; insertion--the femur; action--flexion and external rotation of the thigh. (c) posterial femoral or hamstring muscles--cover the back of the thigh; action--flex the knees, and extend the thigh. (d) principal anterior femoral muscles are the quadriceps and the sartorius. The quadriceps: a four-headed muscle, covering the front of the thigh, each head described as a separate muscle (viz., rectus femoris; vastus externus; vastus internus; and vastus intermedius). The quadriceps is the great extensor of the leg; it also flexes the thigh, and antagonizes the action of the hamstring muscles. The sartorius ("tailor's"muscle) is the longest in the body; it crosses the thigh obliquely from its origin in the ilium to its insertion in the tibia. Its real action is to assist in bending the knee. (e) gastrocnemius and soleus form the calf of the leg. Gastrocnemius arises by two heads from the heads of the femur. Soleus is in front of the gastrocnemius, having its origin in the fibula and in the tibia. The direction of both is downward, and they are inserted into a common tendon (Achilles'), the thickest and strongest in the body, attached to the heel bone (calcaneum). The muscles of the calf possess considerable power, and are constantly called into use in standing, walking, dancing, leaping, etc.

The Skin System.

General Functions: (1) protective covering for the deeper tissues beneath it; (2) organ of feeling (e.g. Sense of touch); and (3) regulator of bodily heat. 4) secretory organ
General Structure: the skin consists of two distinct layers--(1) epidermis,

cuticle, or outer layer; and (2) dermis, derma, cutis vera ("true skin"), immediately below the epidermis.
The epidermis forms a protective covering over every part of the true skin, and is thickest in the palms of the hands and on the soles of the feet, i.e. where the skin is most exposed to friction and to pressure. The epidermis may be subdivided into: (a) the superficial or horny layer; and (b) the germinative layer, so called because it is here the growth (germination) of the epidermal cells takes place, the cells multiplying by cell-division and pushing upwards towards the surface those previously formed. In their upward progress they undergo a chemical transformation, and the soft protoplasmic cells become converted into the flat, horny scales which are constantly being rubbed off the surface of the skin. It is in the deepest cells of the germinative layer that the pigment in the skin of the negro, as well as that of the nipple in white races, is found.
Note: no blood vessels pass into the epidermis.
The derma or true skin is a very sensitive and vascular layer of connective tissue which consists of: (a) a superficial layer, containing small conical elevations, called the papillae, which contain tactile corpuscles that give the skin its sense of touch. (The papillae are large and numerous on the palm of the hand, on the tips of the fingers, and on the corresponding parts of the foot). (b) a deeper layer, made up of white fibrous and elastic tissue, containing networks of blood vessels, lymphatics, and nerves.
The derma passes into the subcutaneous or fatty layer, wherein are found the fat cells, and the coils or ends of sweat glands.
Function of the sweat glands: to pour out their secretion (sweat) upon the surface of the body in order to cool it.
General structure of sweat glands: tubular glands with their blind ends coiled into little balls which are lodged in the derma or in the subcutaneous tissue. Around these coiled ends are many fine blood capillaries which, when the body is heated, give off water, salts, fatty acids, and carbon dioxide--i. e. sweat--which are excreted by the sweat ducts at the surface of the skin, thus aiding in the regulation of body temperature.
The sweat glands are abundant over the whole skin (there are roughly two million of them in the skin), but they are most numerous on the palms of the hands and on the soles of the feet, as well as in the groin, and especially so in the axilla (or arm-pit), where they are larger than in any other part of the body.
Under ordinary circumstances, the perspiration that we are continually throwing off evaporates from the surface of the body without our becoming sensible or aware of it, and it is therefore called insensible perspiration.
When, however, more sweat is poured upon the surface of the skin than can be removed at once by evaporation, and it appears in the form of scattered drops, we call it sensible perspiration.
The amount of perspiration varies greatly, being dependent upon the condition of the atmosphere, the amount of exercise taken, the quantity of liquid ingested, the action of the kidneys, the mental emotions, the action of drugs, and certain diseased conditions. In general, the amount is one quart in 24 hours.
The sweat glands are controlled by the nervous system, which causes them to work rapidly or slowly, according to the heat of the body. That they are connected with the nervous system is shown by the way embarrassment or pain may bring out perspiration.
The sweat glands are known as an appendage of the Skin. Other appendages of the Skin include: hairs, with their sebaceous glands, and nails.
The Hair: grows in a deep pocket in the skin, called the hair follicle.
At the bottom of the follicle is a little mound of connective tissue, known

as the hair papilla, upon which the hair rests and grows by the multiplying and upward-pushing action of the epidermal cells at its base. Like the epidermis, the hair contains neither nerves nor blood vessels. In the connective tissue of the papilla, however, is a rich blood supply, which brings food to the growing cells at the base of the hair. Connected with each follicle is a small muscle called the arrector muscle which, when it contracts--as it will, under the influence of cold or terror, pulls the hair up straight, thus making it "stand on end".

Between the hair and the arrector muscle lies a small saccular gland which secretes a fatty, oily substance (sebum) into the hair follicle. It is called the sebaceous gland, and its secretion lubricates the hair and renders it glossy. These sebaceous glands occur almost everywhere over the skin surface (they do not exist on the palms and the soles), keeping the skin soft and flexible.

Care of the hair: Brushing spreads the oil from the sebaceous gland all along the hair; moreover, it causes good circulation of the blood in the scalp, providing growing cells with food, and oxygen, and carrying away the waste substances. Occasional, but thorough washing will remove the accumulated dust and oil from the hair.

The Nails: composed of clear, horny cells of the epidermis, which grow, not unlike hair, by the multiplication of the soft cells at their roots. Underneath each nail is a vascular bed, called its matrix, which gives the nail its pink appearance. Where the cells are young, however, the blood supply cannot be seen so plainly through them because of their greater opaqueness, and so we see, near the root, a little area whiter than the rest of the nail, called the lunula (little moon).

When a nail is injured, or lost through accident, one will grow in its place, providing the matrix is not destroyed, i.e. providing the cells of the germinative layer are left.

The functions of the nails: Of course, they are to protect the fingers, and to assist in picking up small objects.

Some common skin phenomena: Callous or corn--an extra thickness of epidermal cells caused by constant pressure on a particular part of the body; wart--again, an abnormal growth of epidermal cells, but of unknown origin; blister--due to accumulation of liquid between layers of the epidermis; tan--exposure to the sun or wind causes the pigment in the lowest layers of the epidermis to become more abundant, and the skin becomes "tanned"; similarly, a freckle is a spot in the germinative layer of the epidermis where the pigment is especially abundant; blackheads are closed up hair follicles; acne or pimples are infections of the skin by bacteria. Note: A skin eruption may, but does not necessarily denote some impurity of the blood; there are numerous other causes.

Bodily Heat: The temperature of the human body all over the world is the same, even though the native of Alaska loses much more heat than does a native of the South Sea Islands. Again, in violent exercise a man may produce five or six times as much heat as he would at rest, yet the temperature of his body in exercise and in rest would be nearly the same, i.e. it would centre around 98½ degrees (98.6, to be exact), varying but slightly under healthy conditions. This is due to the fact that not only is the amount of heat that escapes from the body regulated, but that the amount of heat which is produced in the body is also regulated. The skin governs the escape of heat in two ways: (1) has already been mentioned, viz., through the sweat glands; (2) by regulating the amount of blood that comes out into the skin. When the body is cold, the blood vessels of the skin contract and keep the blood in the warm internal parts of the body; when the body is hot, the vessels in the skin open up and allow a larger amount of blood to

come to the outside of the body where it will be cooled.
Although clothes are not in themselves sources of heat, by clothing we can aid the functions of the skin and the maintenance of heat; in fact, the chief physiological use of clothing is to retain the body heat.
In illness the body temperature sometimes falls below normal either because not enough heat is being produced or too much is being lost; but more often it rises above normal owing to the greater breaking down of tissues and to a greater production of heat than is natural.
Not nearly so much heat is produced in fever as in exercise, and the main cause of fever is that not enough heat is lost. The trouble usually is that the sweat glands refuse to work. Then they must be stimulated by artificial means: hot baths and warm coverings will ordinarily lower a small fever, as will also rubbing with alcohol or even with water.
Chills: in illness the skin is usually hot and flushed with blood, but sometimes the blood vessels of the skin are tightly closed, and the blood is kept from coming to the outside of the body where it will be cooled. Then the skin has no warm blood, and the person has a chill--feels cold, even though the inner parts of his body are in a hot fever.
Cold baths: The first effect of a cold bath is to contract the blood vessels of the skin and to send the blood to the inner parts of the body. This action quickens the circulation and respiration, and causes more food to be oxidized in the body, thus producing more heat. Then comes the reaction--the return of the blood to the skin, with its glow of warmth. While this reaction lasts is the best time to come out of the bath, and it should be promoted by good rubbing. If the stay in the cold water is too long, the state of reaction passes off, the skin again becomes pallid, the person feels cold, uncomfortable, and perhaps depressed all day, since the activities of his or her body have been lowered instead of stimulated. The same is true of people who are weak or are unaccustomed to cold water baths, for with them the state of reaction does not follow. Such persons--for whom a cold bath is too great a shock to the nervous system--should bathe only in warm or tepid water.
Hot baths on the whole, have exactly the opposite effects of cold baths. Prolonged hot baths and steam baths are not proper for daily use, however, for, while they promote perspiration, if often repeated, they lower the general vigor of the body.
Tepid baths, on the other hand, have no particular effect on the body.
Time for bathing: despite the common belief, it is quite safe to bathe when warm. But no one should enter a cold bath when feeling chilly, when in a depressed vital condition, or immediately after a meal.
The best time for a cold bath is 2 or 3 hours after breakfast or the noonday meal.
Shower baths: Are far better than cold plunges, since they stimulate both by the coolness of the water and also by the force with which the water comes against the skin; at the same time, shower baths do not chill the body, nor lead to depression by abstracting large amounts of heat.
Room Temperature: cold or underheated rooms are injurious because in them the body loses too much heat and becomes chilled; hot or overheated rooms are injurious because on leaving them, too much heat is lost and the body is chilled. The most common result of chilling the body is what we call a cold. It is practically certain that a cold is a germ disease, and that allowing the body to become too cold weakens the resistance to germs, permitting them to grow and cause colds, pneumonia, influenza, and other respiratory diseases.
Wearing heavy clothing indoors has the same effect as staying in an overheated room, and is therefore one good reason for scant clothing for gym.

work.
Wet clothing is especially liable to cause colds, for it takes the heat out of the body.

The Digestive System.

If the body is an organism for the purpose of converting food and air into energy and into tissue (see opening definition), then the first step in the process is to reduce the food to such a state that it can be absorbed and carried to the tissues. This is the process of Digestion.

The digestive system may be conceived in its simplest form as "a muscular tube into which glands all along its course pour secretions. Some of these glands are embedded in the wall of the tube; some, such as the pancreas and the liver, are so large that they lie outside and discharge their secretion through a duct which empties into the digestive canal. The muscular action of the walls of the canal pushes the food ever onward. The churning of the stomach and intestine mixes the food and breaks it up so that the juices can get to every part of it, then the onward movement carries the residue and waste away so they can be evacuated."

The movements in the mouth consist of the grasping movements of the lips, the grinding action of the teeth, and the rolling of the food by the tongue and cheeks, so that it is intermixed with the secretion of the salivary glands which is being poured out. These movements and the act of swallowing are voluntary, but after they are completed, the movements of the food are beyond the control of the will--i.e. once the food has passed into the pharynx and the esophagus, it cannot be recalled.

The pharynx is about 3 inches long; the esophagus (or gullet) about 10.

The stomach is a bag (15 x 5), the walls of which are largely made up of involuntary or smooth muscle fibres. It is marked off from the intestines by a strong circular muscular band--the pylorus-which remains closed during digestion in the stomach, opening only at intervals (momentarily) to allow the ejection of a well-digested bolus of food into the intestine.

The movements of the stomach consist of (a) a series of waves of contraction, running from the upper end towards the pylorus; and (b) a turning or churning action, a rolling from side to side like an electric washer's.

The stomach empties itself in about four hours, when the food, in various stages of digestion, is carried forward by the intestinal movement, much like the wavy or constrictive movement of the stomach.

The process of digestion is practically completed in the small intestine, into which the liver and the pancreas secrete their juices. Essentially, it is a chemical change of foodstuffs into a form which can be absorbed into the blood and utilized by the body.

The small intestine is the longest part of the alimentary canal, being nearly 22 feet. In its walls are intestinal glands, very similar to the glands of the stomach, and projecting from these walls are finger-like tubes called the villi, which give the intestines a velvety lining, and absorb the food much more rapidly than even a smooth wall could.

A little food does pass into the large intestine, and is there absorbed, while its muscles move onward the indigestible material. The large intestine has no villi.

Where the small intestine opens into the large intestine there is a small, worm-like structure--the vermiform appendix--composed (like the tonsils) of lymphatic tissue. Lymphatic tissue is easily invaded by germs, and when germs get into the lymphatic tissue of the appendix, the resulting inflammation is known as appendicitis, and may be of varying grades of intensity. If the infection goes on to the formation of pus, the pus may